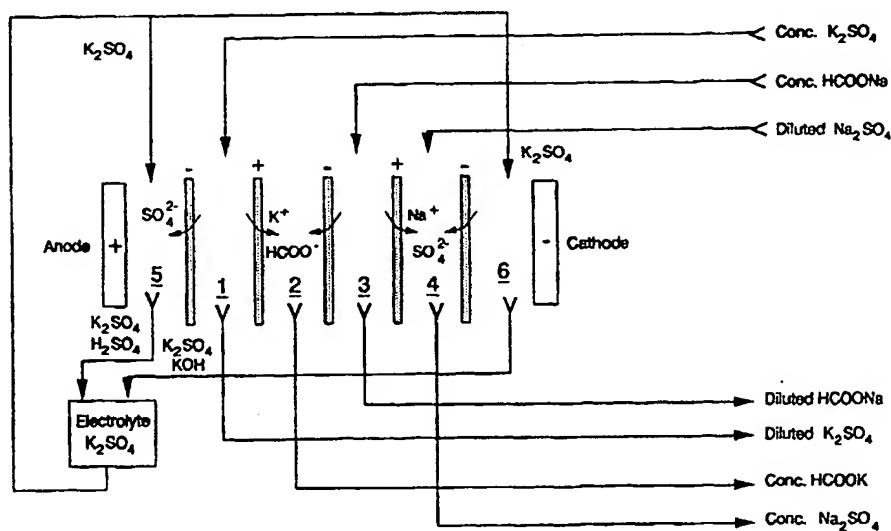




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(54) Title: A PROCESS (III) FOR MAKING POTASSIUM FORMATE



(57) Abstract

A process for making potassium formate, whereby potassium formate yields from an electro dialysis device comprising at least one electro dialysis unit divided into four compartments by alternating cation and anion membranes, at least one anode and at least one cathode. The electro dialysis unit comprises three anion and two cation membranes. The membranes are arranged parallel with an anion membrane closest to both the anode and the cathode. A concentrated aqueous solution of a potassium salt is introduced into a first compartment, a diluted aqueous solution of a sodium salt into a fourth and a concentrated aqueous solution of sodium formate into a third. A concentrated aqueous solution of potassium formate is recovered from the second compartment and a concentrated aqueous solution of a sodium salt from the fourth. The recovered solutions result from an ion exchange through the anion and cation membranes.

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A PROCESS (III) FOR MAKING POTASSIUM FORMATE

The present invention relates to a process for making potassium formate by means of an electrodialysis unit.

Potassium formate is, among other applications, used as a component in well servicing fluids, such as drilling fluids, for land based as well as offshore oil drilling. Well drilling depends on many factors, such as the performance of used well servicing fluids. Drilling fluids prevent uncontrolled influx of formation fluids into the well, removes formation cuttings from beneath the bit and transports them to the surface, seals exposed permeable formations, maintains the stability of exposed formations, cools and lubricates the bit and the drill string at points of contact with the cased or uncased drill hole and helps to suspend the weight of the drill string and casing. A number of physical and chemical properties including the rheological properties, of drilling fluids are monitored to ensure satisfactory performance. A major problem is created when the viscosity reduces with increasing temperature. The rheological properties of polymers, included in drilling fluids as for instance viscosifiers, are often substantially degraded or even lost with an increasing temperature. A well known method of stabilising rheological properties are the combination of brines, such as chlorides and formates of alkali metals, and polymers, which increases the critical temperature of the polymer. Potassium formate has been found to exhibit excellent stabilising properties at high temperatures resulting in a critical temperature exceeding 200°C, as disclosed in the research report "High Temperature Stabilisation of Xanthan in Drilling Fluids by the Use of Formate Salts" by J.D. Downs - Koninklijke/Shell Exploratie en Productie Laboratorium, The Netherlands - Physical Chemistry of Colloids and Interfaces in

Production, Paris 1992 pages 197-202. J.D. Downs gives in said paper a detailed disclosure of formates and their stabilising effect. Furthermore, the European Patent Applications 259 939 and 572 113 also disclose the use of formates in drilling fluids.

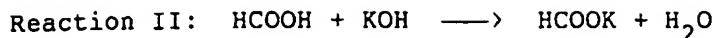
Potassium formate is very suitable to use as a component in drilling fluids. The salt provides a high density, required for deep well drilling, has a solubility in water exceeding that of other formates and is environmentally safe.

Potassium formate is produced by reacting carbon monoxide with potassium hydroxide in accordance with Reaction I below.



The production method according to Reaction I is disclosed in Encyclopedia of Chemical Technology, 3rd. edition, volume 18, page 938. The reaction is fairly slow and carried out by absorbing carbon monoxide, freed of acidic gases, in 50-80% by weight of potassium hydroxide at 100-200°C and at a pressure of CO > 690 kPa (> 100 psi). The disadvantages of producing potassium formate in accordance therewith are obvious and can be summarised: High temperature, high pressure and slow reaction. A high yielding, reliable and industrially applicable process for making potassium formate is presently not available and the availability of said compound is thus limited, being for instance a recovered by-product.

Potassium formate can naturally be made by the fundamental but industrially unsuitable or inconvenient reaction between potassium formate and formic acid according to Reaction II below, yielding 1 mole of industrial waste water per mole of potassium formate.



The present invention provides a process for making potassium formate in an industrially suitable and convenient way, which process eliminates above disadvantages. The process yields potassium formate from an electrodialysis device comprising at least one electrodialysis unit, which unit is divided into four compartments by alternating cation and anion membranes, at least one anode and at least one cathode. The electrodialysis unit comprises three anion and two cation membranes. The membranes are arranged parallelly with an anion membrane closest to both the anode and the cathode. A concentrated aqueous solution of a potassium salt, such as potassium sulphate and/or potassium chloride, is introduced into the first compartment, which compartment is closest to the anode, a diluted aqueous solution of a sodium salt, such as sodium sulphate and/or sodium chloride, is introduced into the forth compartment, which compartment is closest to the cathode and a concentrated aqueous solution of sodium formate is introduced into the third compartment, which compartment is next to the forth one. An electric current is introduced between an anode and a cathode. A concentrated aqueous solution of potassium formate is whereby recovered from the second compartment being next to the first one and a concentrated aqueous solution of a sodium salt, such as sodium sulphate and/or sodium chloride, is recovered from the fourth compartment. The recovered solutions result from an ion migration/exchange through the anion and cation membranes. This ion exchange is induced by said electric current between the anode and the cathode.

In various embodiments are two or more electrodialysis units comprising four compartments combined in such a way that a fifth compartment corresponds to the first compartment, a sixth to the second, a seventh to the third, an eighth to the fourth, a ninth to the first, etc.

In preferred embodiments of the process are at least one electrolyte containing for instance an aqueous solution of a salt, such as potassium sulphate, potassium chloride or sodium formate, allowed to circulate through an anode compartment and a cathode compartment, which compartments not are included in the disclosed electrodialysis unit of four compartments.

The process is preferably a continuous process, but can also be performed as a batch process.

The process according to the present invention has a very low energy consumption and allows a production of large amounts of potassium formate.

These and other objects and the attendant advantages will be more fully understood from the following detailed description, taken in conjunction with appended Figure 1, wherein an electrodialysis unit comprising four compartments 1, 2, 3 and 4 is showed. The unit furthermore comprises three parallelly arranged anion membranes alternating with two likewise parallelly arranged cation membranes. The unit is included in an electrodialysis device comprising, an anode, an anode compartment 5, a cathode, a cathode compartment 6 and a tank holding an electrolyte, in this case potassium sulphate. An anion membrane is arranged closest to both the anode and the cathode. The cation membranes and the anode is characterised by (+) and the anion membranes and the cathode by (-).

A concentrated aqueous solution of potassium sulphate is introduced into compartment 1, a concentrated aqueous solution of sodium formate into compartment 3 and a diluted aqueous solutions of sodium sulphate into compartment 4.

An electric current is introduced between the anode and the cathode and an electrolyte containing potassium sulphate is

allowed to circulate from a tank through the anode 5 and the cathode 6 compartments.

A diluted aqueous solution of potassium sulphate is recovered from compartment 1, a concentrated aqueous solution of potassium formate from compartment 2, a diluted aqueous solution of sodium formate from compartment 3 and a concentrated aqueous solution of sodium sulphate from compartment 4.

Hydrogen (H_2) is emitted at the cathode and oxygen (O_2) at the anode. The electrolyte is by circulation from the anode to the cathode returned, in this case as potassium sulphate.

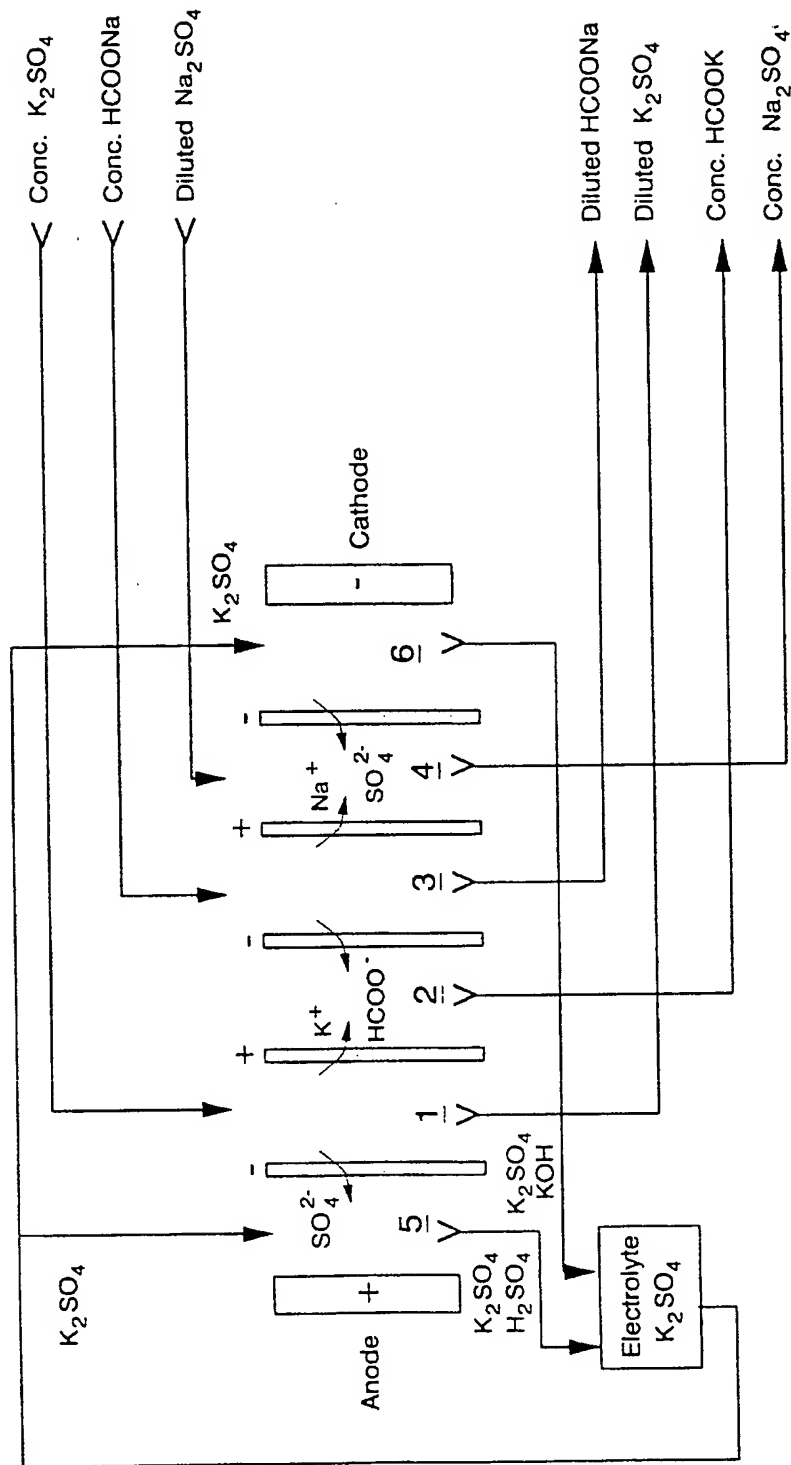
While a particular embodiment of the invention have been shown, it will be understood, of course, that the invention is not limited thereto since many modifications may be made, and it is, therefore, contemplated to cover by the appended claims any such modifications as fall within the true spirit and scope of the invention.

CLAIMS

1. A process for making potassium formate characterised in, that
- a) the potassium formate yield from an electrodialysis device comprising at least one electrodialysis unit being divided into four compartments (1, 2, 3 and 4) by two cation and three anion membranes, the membranes being alternating, at least one anode and at least one cathode,
 - b) the membranes are arranged parallelly with an anion membrane being arranged closest to both the anode and the cathode,
 - c) a concentrated aqueous solution of a potassium salt, such as potassium sulphate and/or potassium chloride, is introduced into a first compartment (1), the compartment (1) being closest to the anode,
 - d) a diluted aqueous solution of a sodium salt, such as sodium sulphate and/or sodium chloride, is introduced into a forth compartment (4), the compartment (4) being closest to the cathode and
 - e) a concentrated aqueous solution of sodium formate is introduced into a third compartment (3), the compartment (3) being next to the forth compartment (4),
 - f) that an electric current is introduced between the anode and the cathode,
- whereby a concentrated aqueous solution of potassium formate is recovered from a second compartment (2) being next to the first compartment (1), and whereby a concentrated aqueous solution of a sodium salt, such as sodium sulphate and/or sodium chloride, is recovered from the fourth compartment (4), the recovered solutions resulting from ion migration/exchange induced by the electric current through the anion membranes and cation membranes, respectively.

2. A process according to claim 1
characterised in, that
two or more electrodialysis units comprising four compartments (1, 2, 3 and 4) are combined.
3. A process according to claim 1 or 2
characterised in, that
at least one electrolyte is allowed to circulate through
an anode compartment (5) and a cathode compartment (6).
4. A process according to claim 3
characterised in, that
the electrolyte contains an aqueous solution of potassium
sulphate, potassium chloride and/or sodium formate
5. A process according to any of the claims 1 - 4
characterised in, that
the process is a continuous process.

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Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 95/00727

A. CLASSIFICATION OF SUBJECT MATTER		
IPC6: C07C 53/06, B01D 13/02 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC6: C07C, B01D		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE,DK,FI,NO classes as above		
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CA, WPI, IFIPAT		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3779883 A (ALLYN H. HEIT), 18 December 1973 (18.12.73)	1-5
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A	EP 0242784 A1 (PERSTORP AB), 28 October 1987 (28.10.87)	1-5
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<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
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Date of the actual completion of the international search		Date of mailing of the international search report
4 October 1995		21.10.95
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86		Authorized officer Eva Johansson Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

28/08/95

International application No.
PCT/SE 95/00727

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3779883	18/12/73	NONE	
EP-A1- 0242784	28/10/87	JP-A- 62289535 SE-A- 8601772	16/12/87 19/10/87